EGU2020-18713
https://doi.org/10.5194/egusphere-egu2020-18713
EGU General Assembly 2020

Quantifying the uncertainty in the prediction of soil properties from soil-spectra using local and regional spectral libraries

Timo Breure[1,2], Alice Milne[1], Richard Webster[1], Stephan M. Haefele[1], Jacqueline A. Hannam[2], and Ronald Corstanje[2]
[1]Rothamsted Research, Harpenden, Hertfordshire, United Kingdom of Great Britain and Northern Ireland (timo.breure@rothamsted.ac.uk)
[2]Cranfield University, Cranfield, Bedfordshire, United Kingdom of Great Britain and Northern Ireland

Spectral measurements are increasingly used to predict soil properties. Libraries of soil spectra are built and statistical models are used to relate the spectra to wet chemistry measurements. These relationships can then be used to predict the properties of new samples. An important consideration is the uncertainty associated with the prediction. Often to reduce this error calibration is done at field level. This is time and resource intensive, however, and there is scope to use existing spectral libraries. Our aim was to quantify the uncertainty in the prediction of soil properties from spectral measurements using a local library and compare this to predictions made using a regional library.

To investigate this, we considered two case study fields in the Cambridgeshire fens (UK) that were planted with lettuce. These fields contain complex soils which are a combination of peat with underlying alluvial and marine silts that became elevated features in the landscape due to peat oxidation and shrinkage. These elevated features are captured by a 2 m x 2 m LiDAR raster used in our study (UK Environment Agency). We took a total 467 soil samples across the fields and made spectral measurements (near- and mid-infrared). A subset of the soil samples underwent wet chemistry analysis for available pH, P, K, total N and soil particle size fraction. For the regional library we use soil the National Soil Inventory spectral database and its respective wet chemistry reference values.

We used partial least squares to regress the soil spectra for the local and regional spectral libraries against the wet chemistry reference values. These two models were then used to predict the soil properties for both fields. We then mapped the variation in each soil property and the associated uncertainty by kriging. The variation in some of the soil variables was clearly affected by elevation and there were signs of spatial trend and so we used universal kriging to map the soil properties. To reduce bias, we used residual maximum likelihood estimation (REML) to estimate the variogram by fitting a linear mixed model with the trend accounted for as fixed effects. We compared these different maps to assess how the calibration regression from local and regional spectral libraries translates itself in uncertainty of kriged maps for five different soil properties within each field.